VISTAS

Visualization of Terrestrial & Aquatic Systems

Exploring data on topographically complex landscapes

http://blogs.evergreen.edu/vistas

An Interdisciplinary Team of
Computer Scientists, Social Scientists and Environmental Scientists

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Acknowledgements

VISTAS team: prior developers: Viriya Ratanasanpunth, Chris Schmidt, Patrick Wingo, Justin Mangue, Kendra Schmal. PhD student: Kirstsen Winters. Sr. Personnel: Susan Stafford.

VISTAS collaborators & users: Robert Kennedy, Bob McKane, John Bolte, Christoph Thomas, Allen Brookes, Patrick Wingo, Dominique Bachelet, Larry Mahrt, Jonathan Halama

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1. What is VISTAS – goals & objectives
2. Some VISTAS visualizations
3. Features
4. Demo
5. Futures
6. Becoming a VISTAS user
7. More info, contact us & discussion

VISTAS Goal

…research, develop, and validate *visual analytics* –
so environmental scientists can
better understand and communicate
ecological processes that
span spatial and temporal scales.

VISTAS' niche: *Topography matters!*

The effects of complex topography over time
on ecological processes is
poorly understood and difficult to study.

VISTAS Objectives

1. **Conduct research & co-develop a proof of concept: VISTAS**

2. **Conduct environmental science research using VISTAS**

3. **Study VISTAS' co-development, visual analytics, usability**

VISTAS Objectives

1. **Conduct research & co-develop a proof of concept: VISTAS**

   A C++ prototype, freely available for Windows, that uses modern graphics (GPUs), and takes as input

   - **Gridded ASCII, NetCDF or shapefiles,**
   - **Geographic locations (coordinates) and desired resolution.**

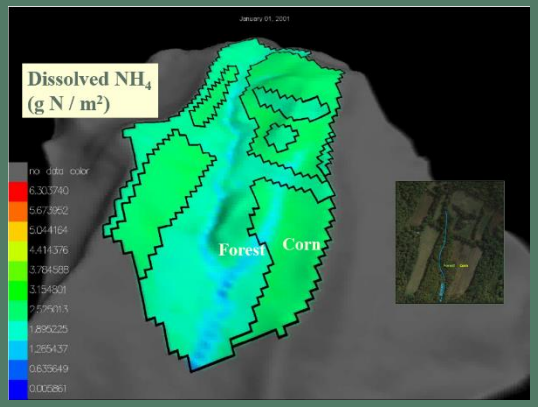
2. **Conduct environmental science research using VISTAS**

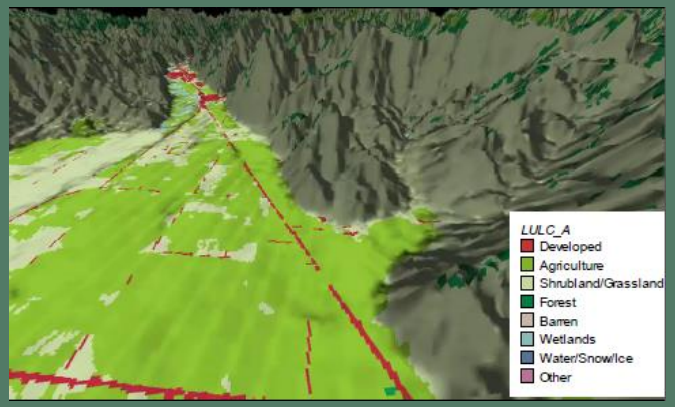
   Address *wicked problems* presented by climate change and complex systems

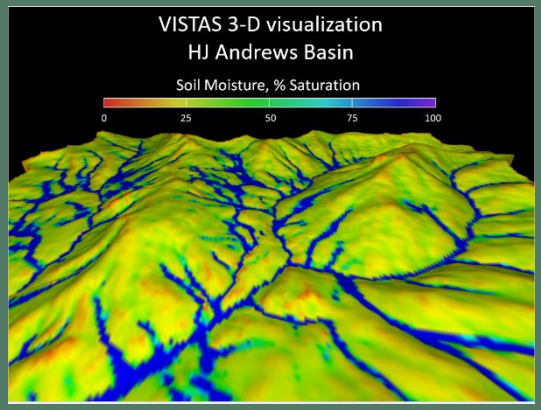
3. **Study VISTAS' co-development, visual analytics, usability**

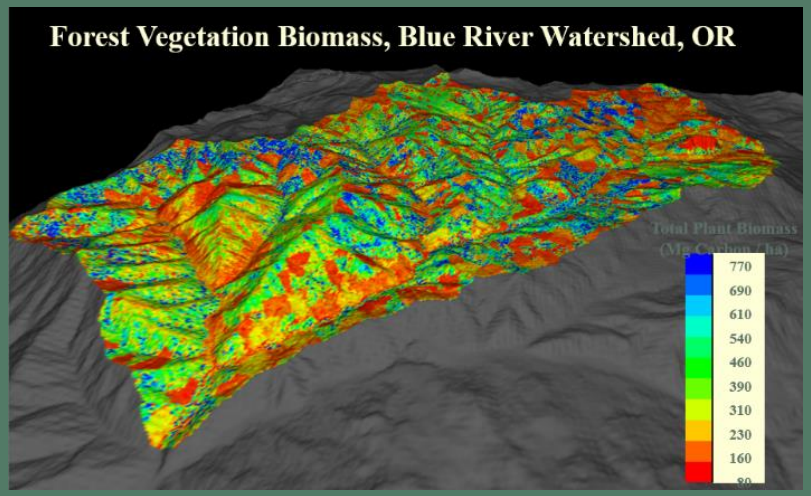
   - **Which vis works – for scientists? for decision makers?**
   - **What do users need to know to use VISTAS?**
   - **What should co-developers know –**
     when developing software to address wicked problems?

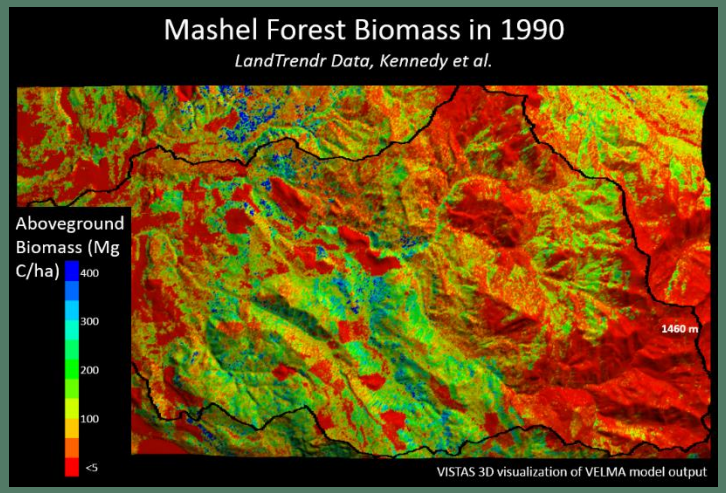
Some VISTAS Visualizations







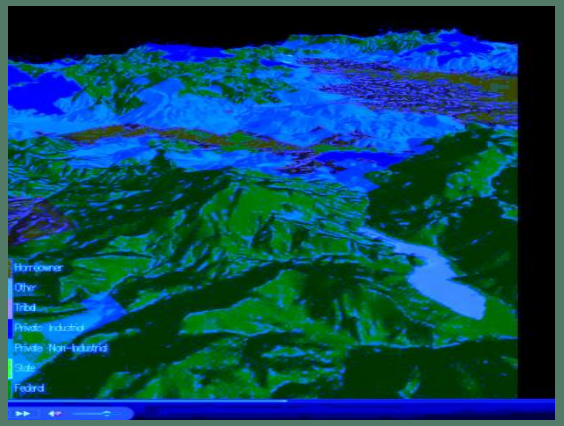


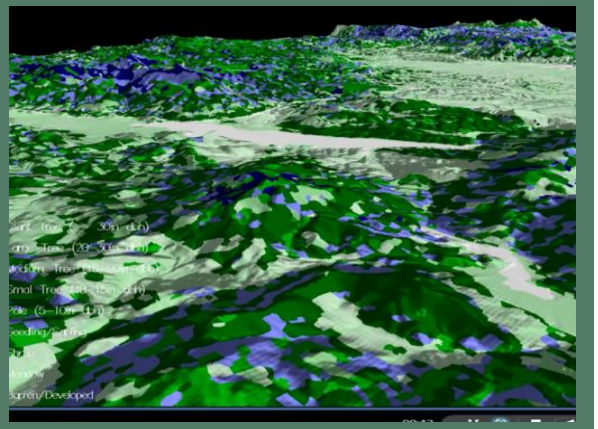


For more images, view the gallery at: http://blogs.evergreen.edu/vistas/

June 11, 2014 VISTAS Flythrough, Lakeview, Oregon

Given two ENVISION shapefiles, VISTAS generated stills and flythroughs of a single time slice to show fire disturbance potential



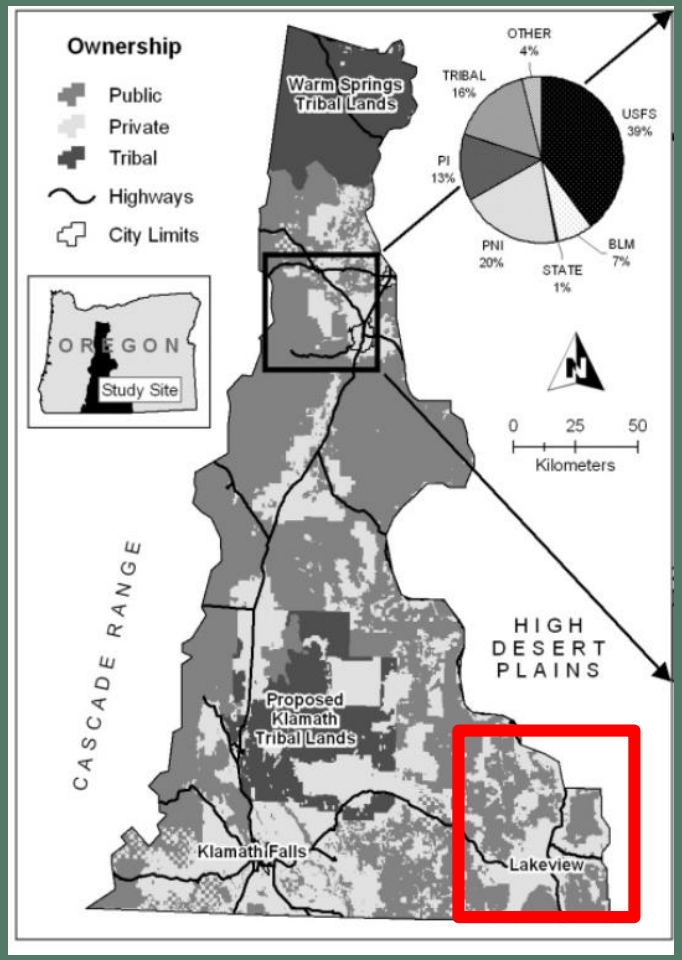


Vegetation size (habitat)

- Giant Tree (>30” dbh)
- Large Tree (20-30” dbh)
- Medium Tree (15-20” dbh)
- Small Tree (10-15” dbh)
- Pole (5-10” dbh)
- Seedling/Sapling
- Shrub
- Meadow
- Barren/Developed

Ownership

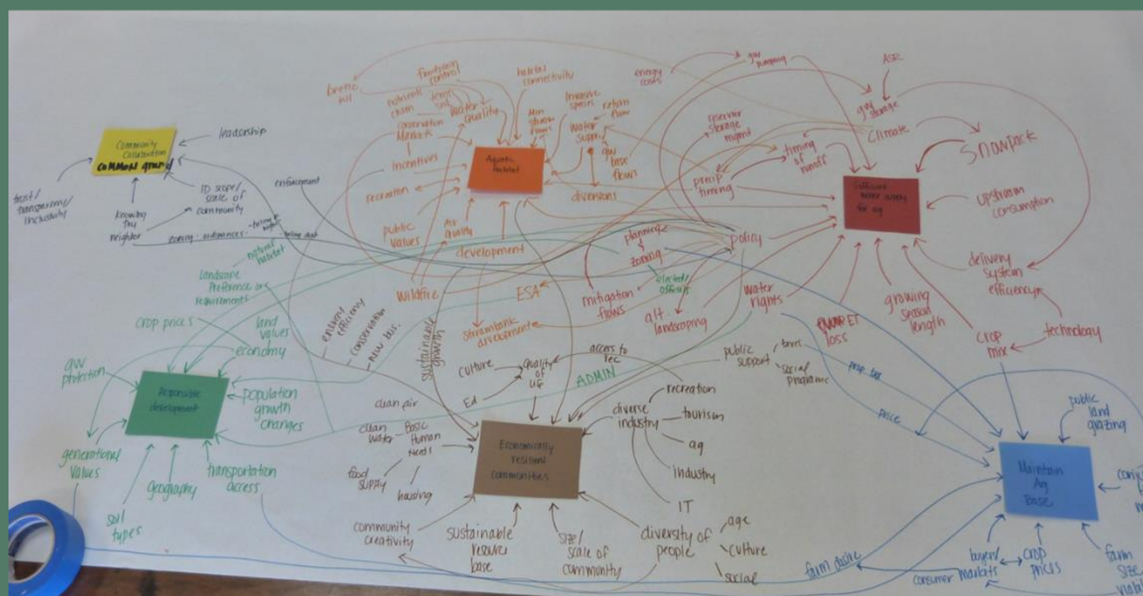
- Homeowner
- Other
- Tribal
- Private – Industrial
- Private – Non-Industrial
- State
- Federal



Data provided by John Bolte, Emily Platt, and Tom Spies

Alternative Land-Use Scenarios
Big Wood Basin (Idaho)
Co-developing Knowledge





Alternative Land-Use Scenarios
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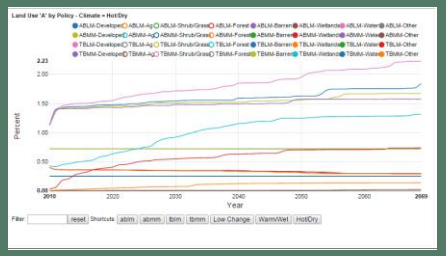
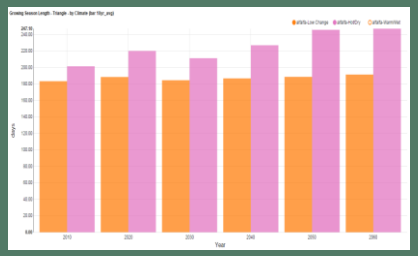
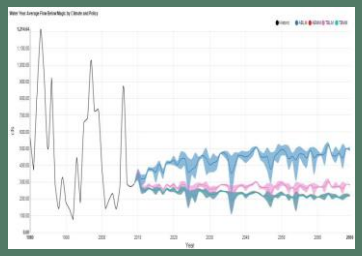
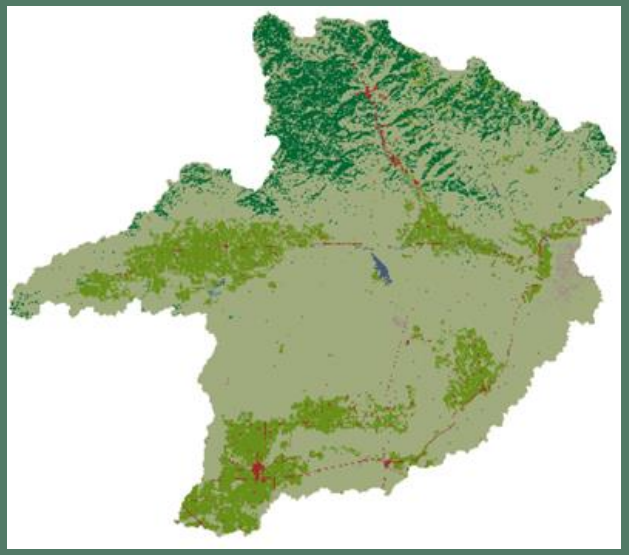
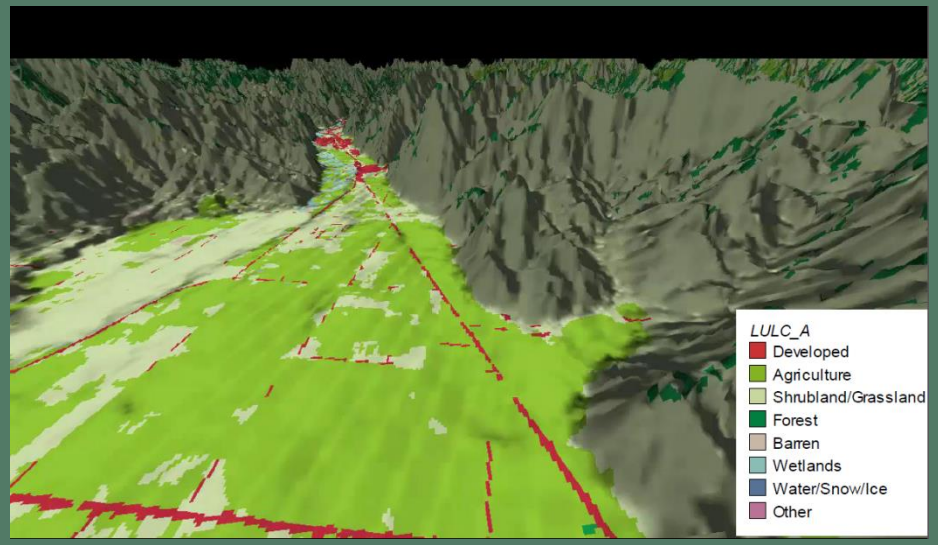




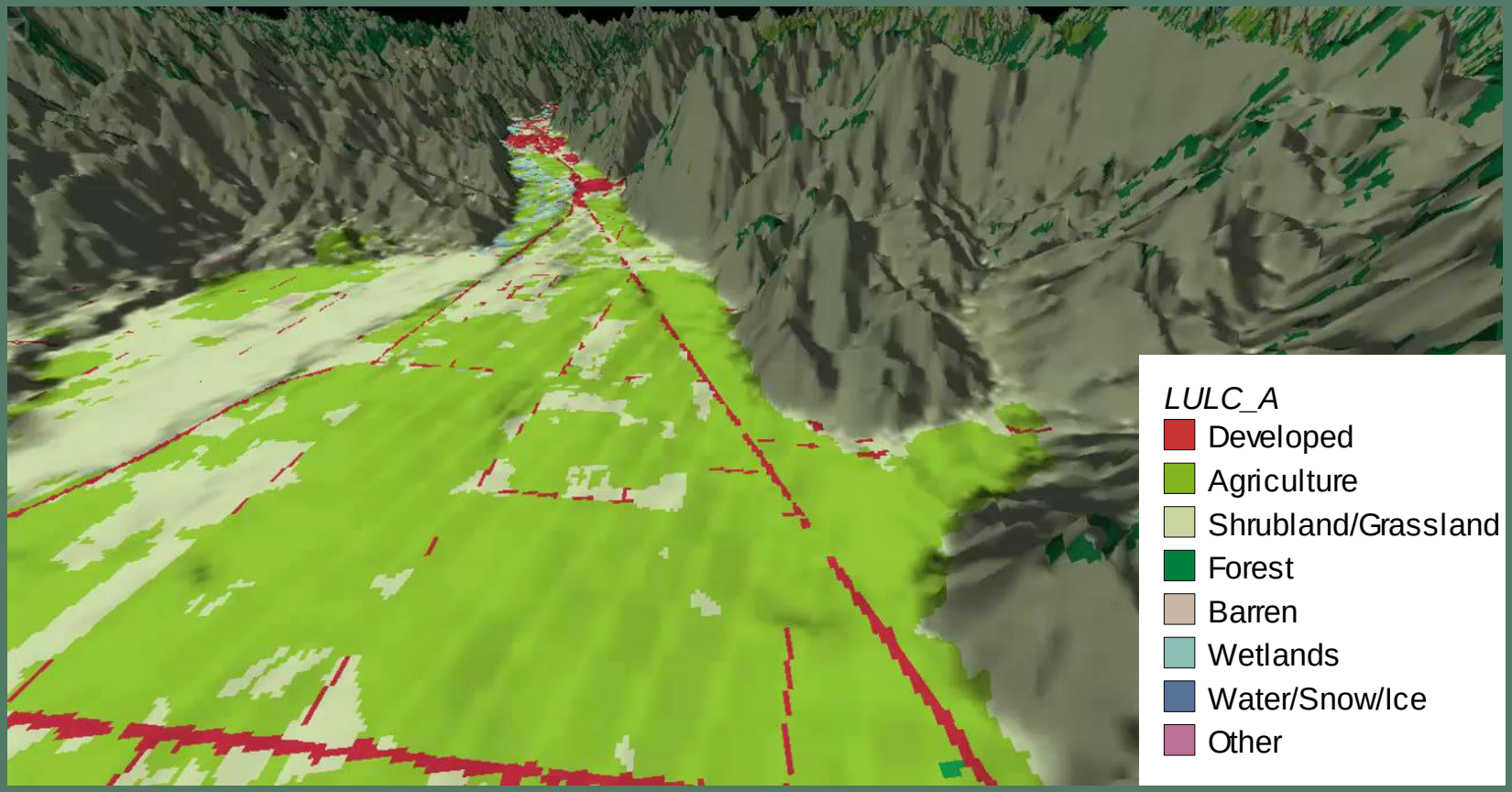


From line charts and bar graphs to 3D landscapes



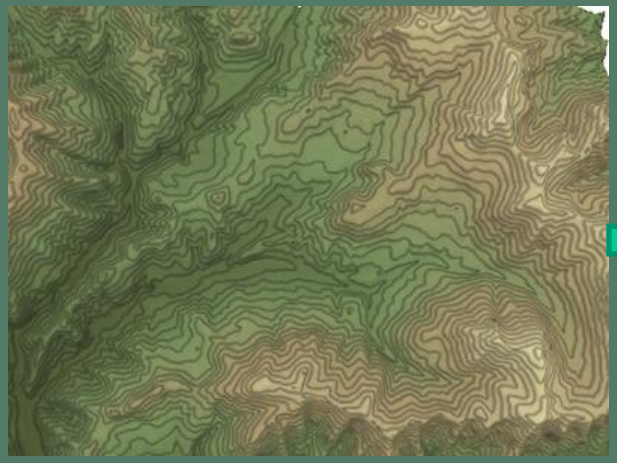


Big Wood: flythrough video



2014 Web Prototype
Visualize Wind Flow at HJ Andrews LTER (Oregon)

‘Flat’ topo maps are difficult to read



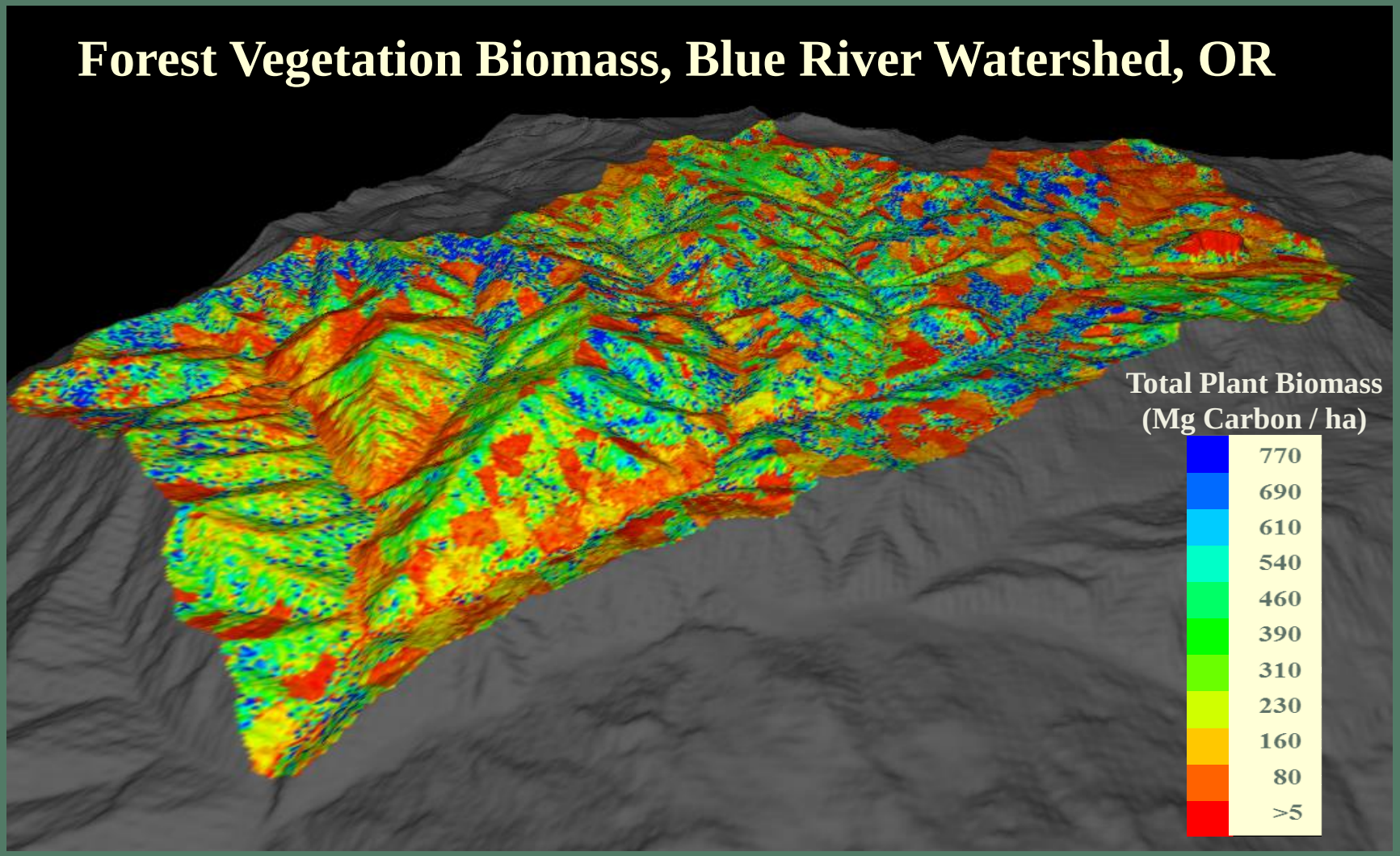
Zoom in on valley of interest

Wind Flow over time

Data provided by C. Thomas, J. Walley

Hydrological-Biogeochemical Processes

Topography is important

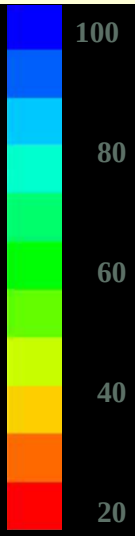


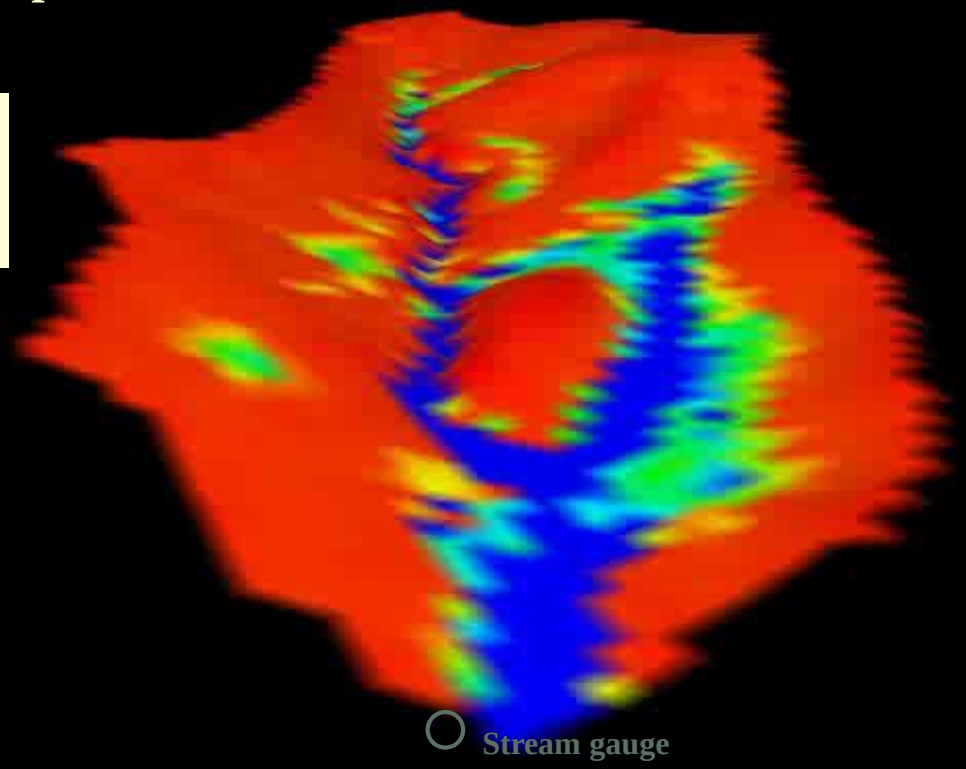
Soil Moisture
2000-01-01

Do forest buffers reduce runoff to Chesapeake Bay?

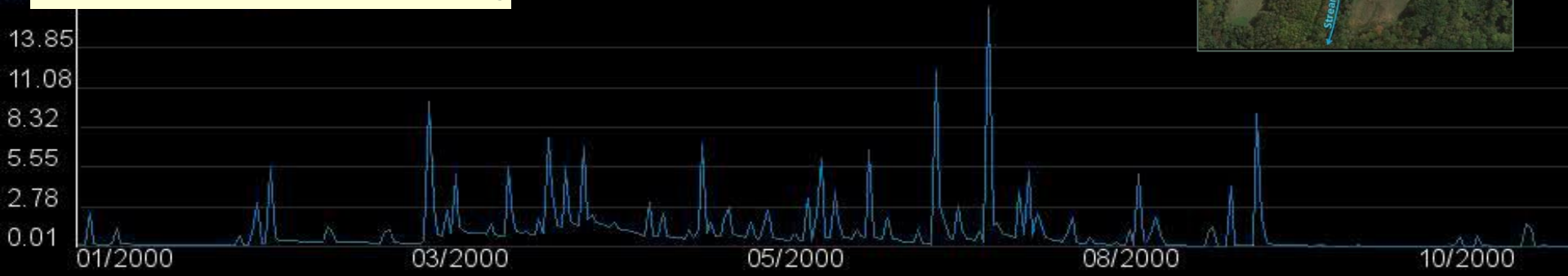
Animation illustrates processes over time

Soil Moisture (% Saturation)





Simulated Streamflow, mm/day



January 01, 2001

Scientists had internalized land use boundaries, but stakeholders needed these

Dissolved NH_4 ($g\ N / m^2$)

no data color
6.303740
5.673952
5.044164
4.414376
3.784588
3.154801
2.525013
1.895225
1.265437
0.635649
0.005861

Forest

Corn

VISTAS Features (overview)

- **Given:**
  - gridded data of one or more features
  - elevation data of area of interest
- **VISTAS will**
  - generate a “3D” map, and
  - drape the feature(s) across the landscape
- **You can then**
  - view & explore the map
    - *over time—animation*
    - *over space—flythrough*
    - *over data—inspect, filter*
  - annotate the map with 2D graphs of related variables
  - label the map for clarity
  - use the map to validate or debug data and/or models
  - save your project with visualization(s)
- **Export visualizations for presentation**

A VISTAS Demo:

Try VISTAS…

http://blogs.evergreen.edu/vistas/

At …vistas/vistas-software you will find:

- **VISTAS Introduction (these slides +)**
- **How to download VISTAS EXE & sample files**
- **User documentation**
  - **Quickstart manuals**
  - **How to videos**
- **Developer documentation**
- **Links to freely available source files**

NOTE: Some experience with GIS software will be helpful.

VISTAS' Futures

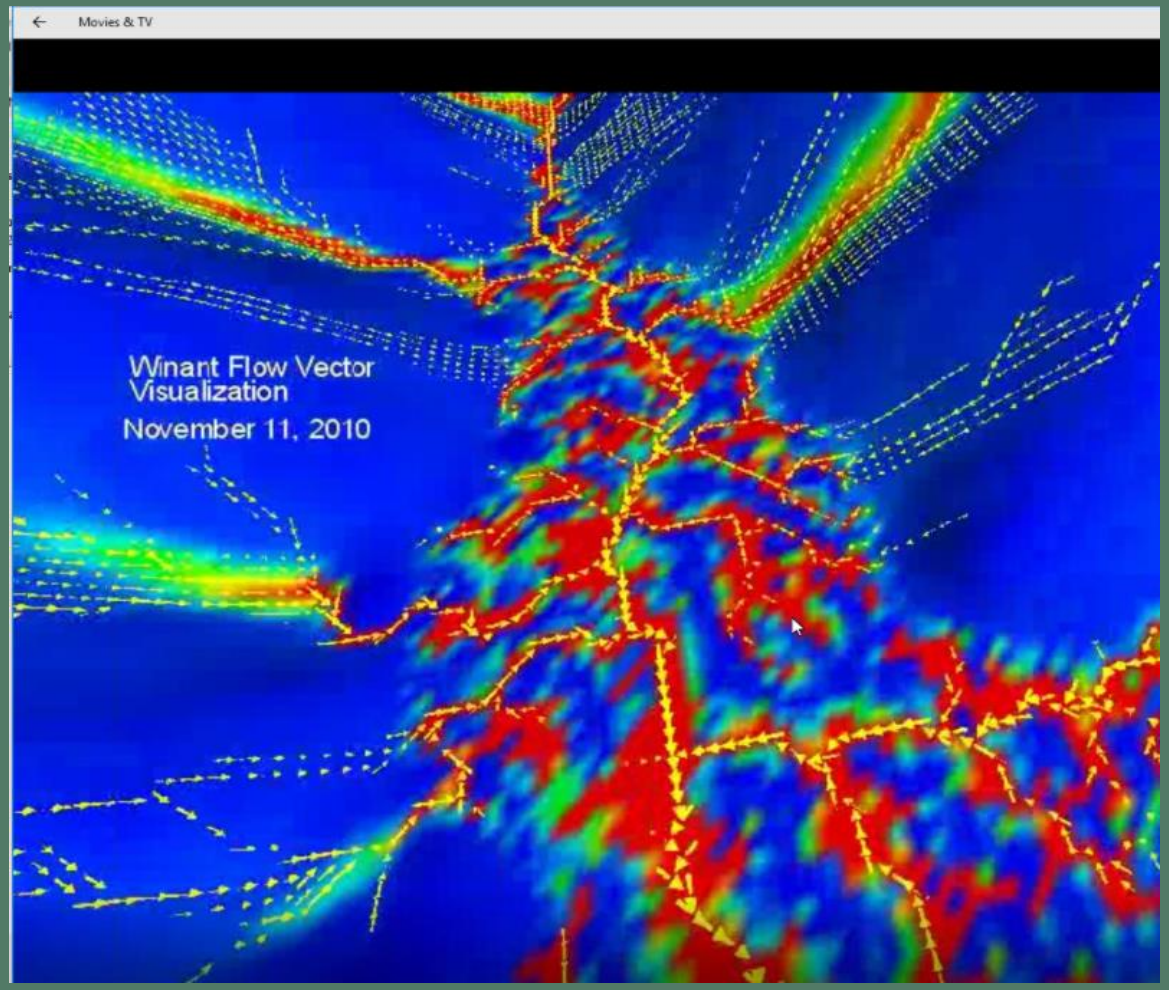
1. **Refine & Sustain the Software**
   - Better documentation
   - Improved usability & extensibility
   - Community sustainability

2. **Getting to Why**
   - Enhanced visualization – flow
   - Visual analytics, machine learning
     - -Identification & detection of hot spots (features)
     - -Where and why features change over time

3. **Social Science Research**
   - Which visualizations work, for whom, when

Hydrological-Biogeochemical Processes
an Oregon salt marsh

- **Arrows indicate flow direction**
- **Background colors, magnitude of groundwater lateral flow**
- **Soil moisture is predicted by a hydrological model**
- **Water flow is based on topography**



Video at:
https://www.dropbox.com/s/s5rtf93wx3uewk4/myvectortest.wmv?dl=0

Contact Us

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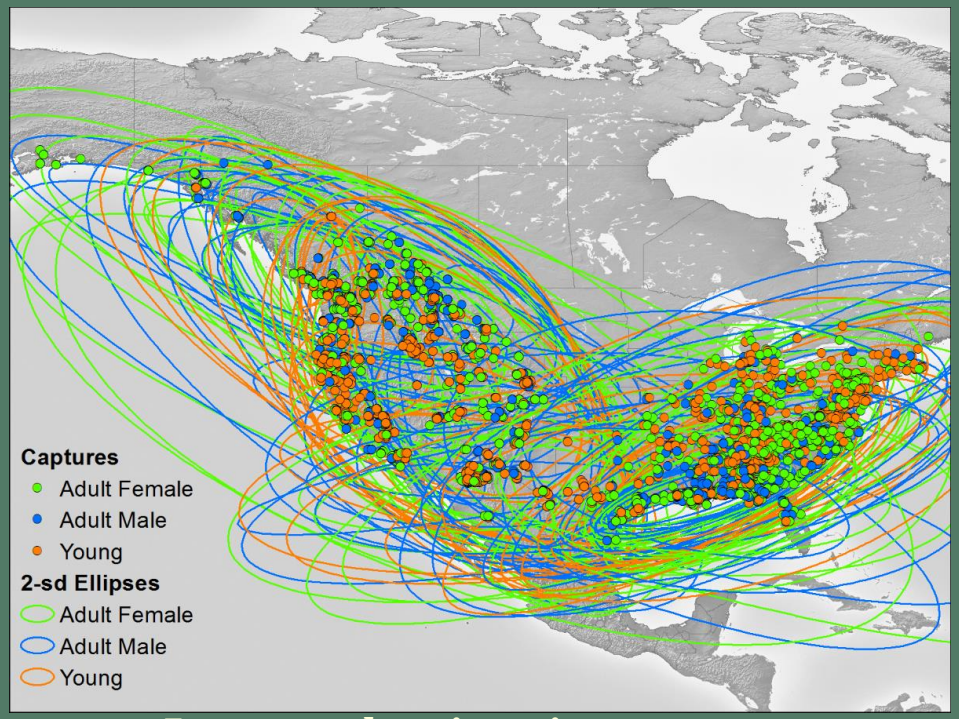
Taylor.mutch@cbi.org

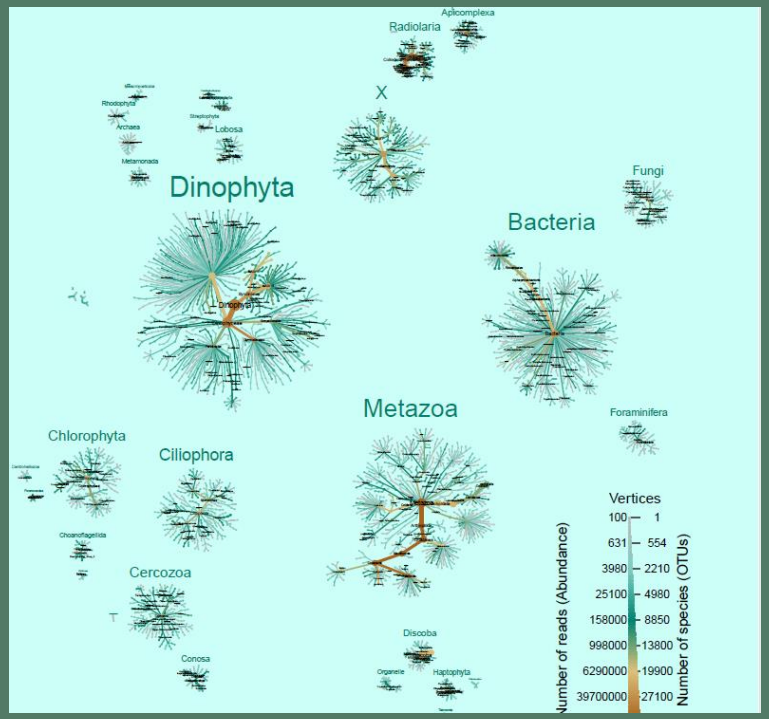
NSF ABI-BIO 10-62572,

The PNW EcoVizzies 2016

Stay tuned for the 2017 contest !!!!
Please submit <u>your</u> visualization(s)!



Large scale migration patterns of Rufous Hummingbirds (Josee Rousseau)



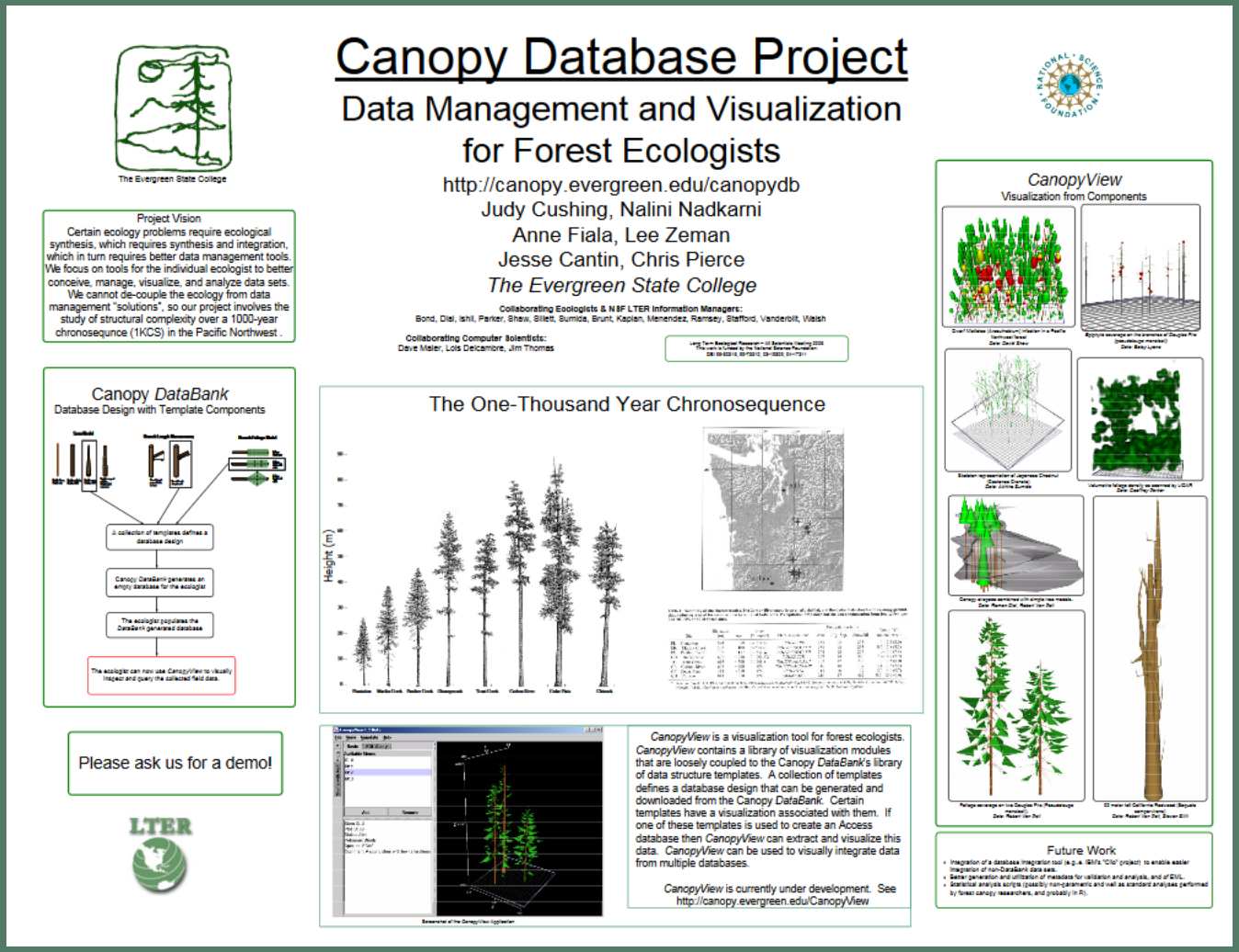
Eukaryotic plankton diversity in sunlit ocean (Tara Foster)

VISTAS Backstory

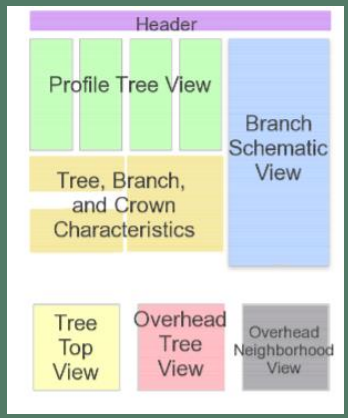
NSF DBI 04-17311, CISE 01-31952, BIR 03-19309, 99-75510, 96-3O316, 93-07771

http:///canopy.evergreen/edu/scidb

http:///archives.evergreen.edu/webpages/projects/scidb/index.html



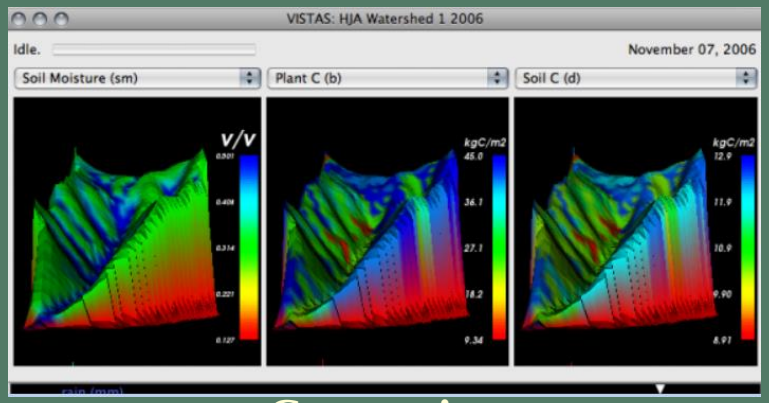
1994 – 2006
Manage & visualize Canopy Science field data



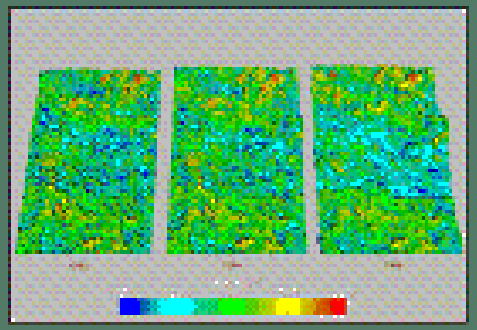
WA DNR Leave Tree Project

VISTAS Backstory (2005 - 2010)

toward terrain modeling & animations over time

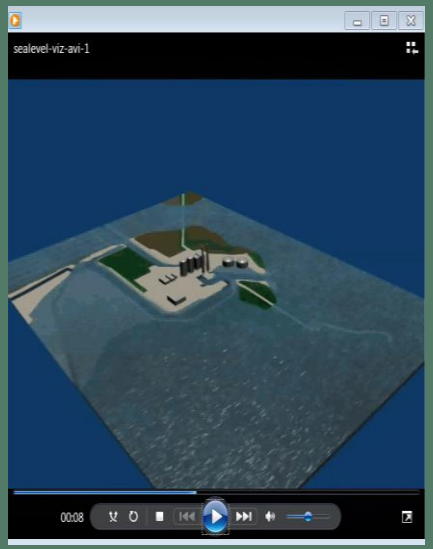


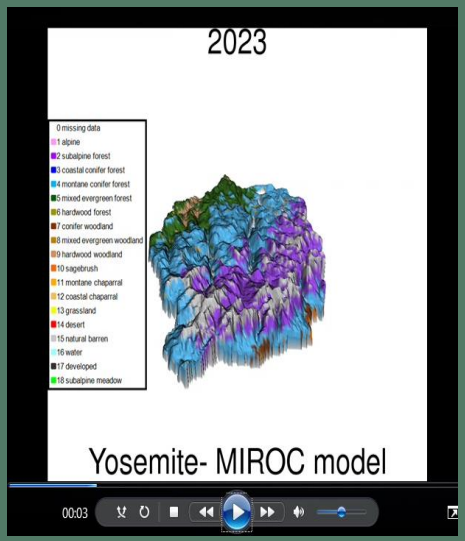
Comparing
Soil Moisture, Plant and Soil Carbon at the HJA LTER



View forest regrowth after hurricane disturbance
Luquillo LTER, Puerto Rico

Sea Level Rise
Turkey Pt,
St. Lucie
nuclear reactors





Vegetation change due to projected climate change

VISTAS
Ongoing Social Science Research
Which visualizations work, for whom?

Characterizing Scientists' Needs

	EXPLORATION	COMMUNICATION
CHALLENGES	• combining statistics & visualization • separating signal from noise • data variety & volume	• validating results • simplifying results • externalizing complex thought experiments • representing uncertainty
OPPORTUNITIES	• visualization - 3D models - multiple scales (spatial & temporal)	• photorealism? • "audience" appeal • real-time visual analytics

Ask VISTAS Science Collaborators

"Which visualizations work, for whom?"

	Scientists	**Stakeholders**
ENVISION	Not needed. ENVISION vis – flat & polygonal but sufficient	People think in landmarks: 3D maps draw them in. Animation holds attention
VELMA	3D movies and graphics illuminate interactions & system level controls	3D **still** landscapes – reveal how environment changes Not interested in why….
MICRO-MET	3D wind stills & animation Help build a model from sensed data	Stakeholders ARE scientists
CLIMATE CHANGE IMPACTS	3D movies and graphics illuminate interactions When, where, what, WHY?	3D movies and graphics illuminate interactions Want to know why….